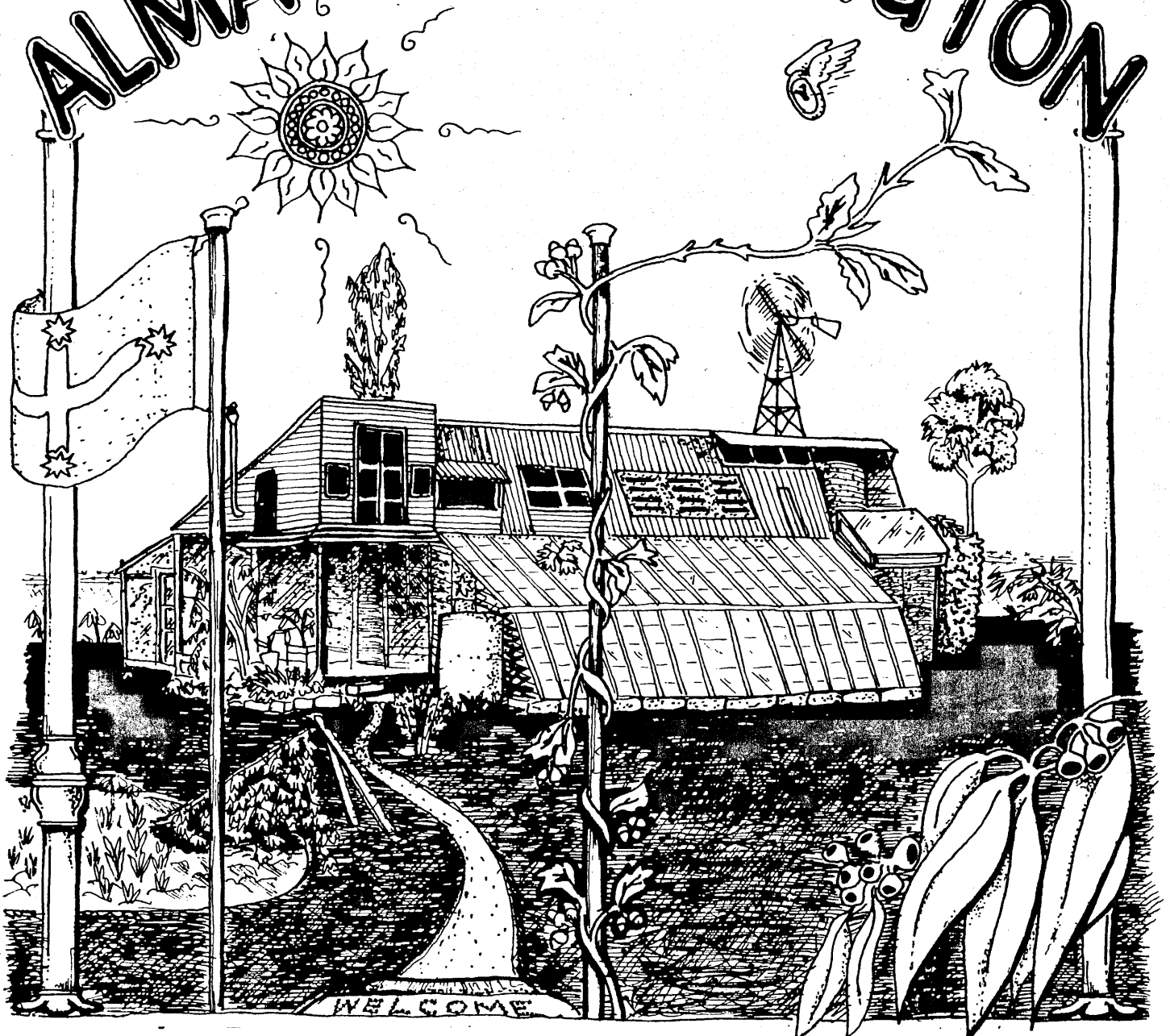




ALMA ST DARLINGTON



The initial aims of the project were to demonstrate that a house could be built with recycled wastes from the city and that the house could be independent of reticulated services and able to recycle its own waste – the inhabitants having complete control over their own lifestyle and welfare.

To a large extent the first aim has been achieved with materials being scavenged mainly from demolition sites in the immediate area – many of the materials having been regarded as unfit for re-use.

The construction of the house was undertaken in mid 1974 by 17 second and third year architecture students, having little prior building experience. The complexity of the problem and the number of variables precluded the traditional practice of working from design drawings and resulted in the house progressing according to what materials came to hand and the people who were present to put them together.

As the occupancy of the house has changed, so the performance requirements were redefined and the house has undergone continual modification – the nature of the house means that it will never be 'finished' in the conventional sense. The house as it is now is a reflection of the needs, at this point of time, of the present occupants and as such it does not present 'the answer' – it presents one specific view in a wide range of alternatives.

Perhaps true autonomy also means freedom from commercial radio, television, daily papers and advertising which do much to determine what people think they need. Entertainment in this house has been largely self-generated, this has meant making conversation and music which was found to be more personally productive than accepting external stimulation. People can be extremely adaptable to new situations, the absence of former comforts seems to be quickly forgotten, a good indication of how non-essential they actually are.

The curtain divided sleeping lofts of the autonomous house, although lacking aural privacy, are in some respects more private than conventional bedrooms. The extremely small size of the spaces means that they are rarely visited, even by other members of the house and so they remain a space 'sacred' to the occupant.

The degree to which this house could be self-sufficient depended largely upon site qualities and resources available and how these corresponded with the requirements of the occupants. Few sites would have all the prerequisites for self-sufficiency and so it meant developing what was available and rationalising the usage of what must be supplied from external sources.

The house, then, is not so much a showplace of alternative technology, but more the physical manifestation of a particular lifestyle.

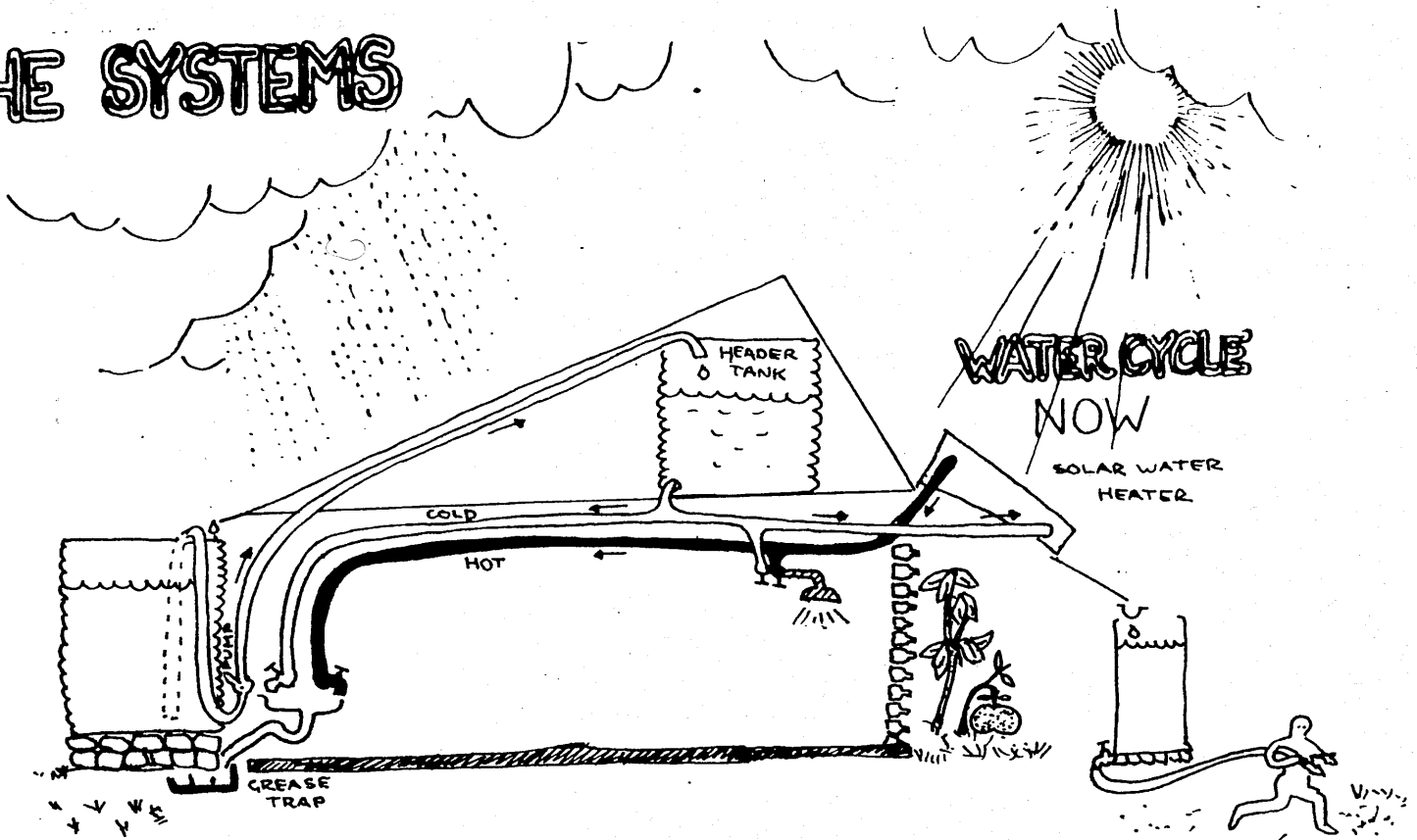
Box 456 Wentworth Bldg,
 Sydney University,
 N.S.W. 2006
 Australia

54 Alma Street,
 Darlington,
 Sydney



AUTONOMOUS HOUSE

THE SYSTEMS



WATER CYCLE

NOW — The roof area is calculated to provide sufficient rain water run-off for 4-5 people in Sydney's rainfall. The water is collected in a 2000 gal. tank which sits on the ground. The water is then pumped up to a 400 gal. header tank. This tank holds an adequate reserve for hot and cold water requirements. A person can pump 40-50 gals. of water up to the header tank in 5 minutes at two strokes/second. But unless pumping is done regularly the tank drains and an air lock forms between the H.W. tank and the taps. To pump up enough head of water to clear this block can be quite a chore.

The smaller northern roof and greenhouse roof water run-off is collected in a smaller tank which is for garden watering.

The Solar Hot Water Heater contains 176 litres (about 35 gallons) of water, and is made of galvanized steel. It consists of a flat tank containing water, blackened on the sun-facing side. Over this are several layers of Polyvinyl fluoride plastic (DuPont 'TEDLAR'), while the sides and underneath the tank are insulated with 100mm (4") of ACT Pink Balls.

Considering it has no booster, the Heater works very well. It provides hot water (up to 80°C on some days) for washing and showering for at least six to eight months of the year. Tests indicate it has a slightly superior efficiency to a normal flat plate collector with a non-selective surface. Its advantage is that it is easier to make and requires no separate hot water storage. Its main disadvantage is that heat losses from the uncovered collector are high at night time and on cloudy days.

PROJECTED — The header tank should be positioned 1½ metres higher than now. Raising the roof will allow a higher gutter which will supply our header tank with rain water and lessen the amount of hand pumping which the residents must do at the moment to keep the header tank topped up. Rain water in the city needs to be filtered of dust, sulphur and heavy metals. In this area, heavy metals — lead, zinc, cadmium, are in quantities well below 'safe allowable', as tested by the Water Board.

HEATING

NOW — Roof and wall insulation of fibre glass wool and sisalation. The bottle wall and greenhouse acts as a solar space heating system.

The bottles are filled with water which acts as a heat store. Vents in the bottom and top of the bottle wall facilitates warm air circulation through the house. On very cold nights the fuel stove needs to be used.

COOLING

NOW — Because the bottle wall stores heat, there should be an insulating curtain between the wall and the inside of the house. The heat rising in the greenhouse through the vents at the top draws more air from inside the house through vents at the bottom of the bottle wall: this improves cross-ventilation from cool shady areas of verandahs.

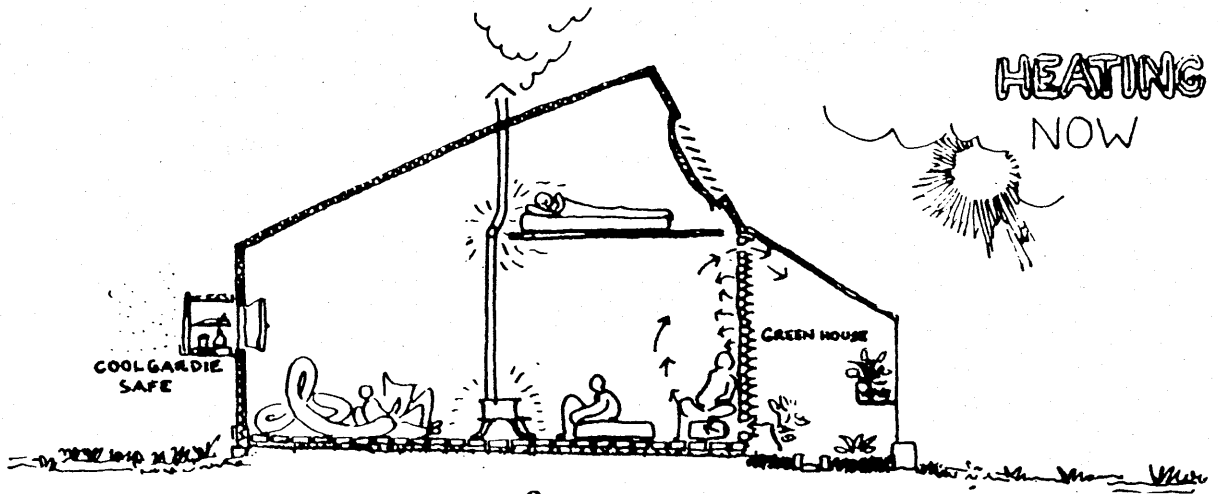
East and west verandahs are shaded. The doors on the eastern verandah can swivel and channel breeze into and through the house. The house, being one big multi-purpose room gets plenty of cross ventilation.

A Coolgardie Safe (evaporative cooler) is used as a cold food store. It is a perforated metal box with a tray for water at the top, and a tray underneath. Cloth is draped over the sides of the box from the tray. Water trickles down the cloth, evaporates and draws heat from the inside of the box. This works very well in hot climates with low humidity. In Sydney's summers the humidity is usually high, but it was found this old method of storing food was satisfactory.

The bottle-wall and greenhouse idea is an adaptation of the Trombe-Michelle wall. By enlarging the thin glazed space on the outside of a Trombe-Michelle wall to a greenhouse the heat from the bottles also heat the large volume of the greenhouse.

The shape of the greenhouse does not facilitate the same sort of air flow as is required by the Trombe-Michelle wall. An advantage is that the greenery in the greenhouse provides fresher air for the rest of the house, the vegetation acting as an air freshener.

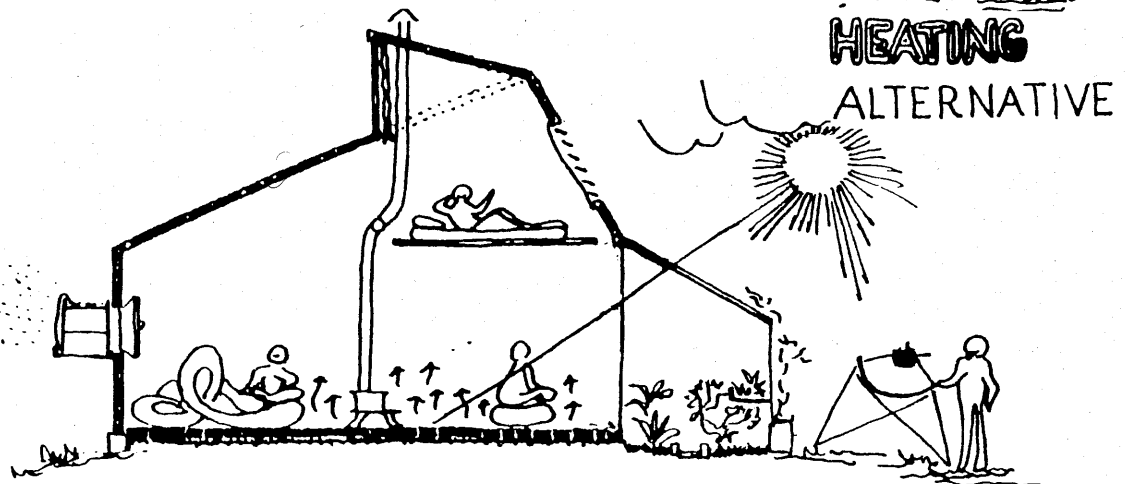
The bottle wall glows with amber light and is a visual delight, so it has not been insulated on the inside surface. So, in winter, the heat from the bottles radiates straight into the house. In the summer this has not been a problem because of the good cross-ventilation, but it would be more efficient to have an insulating curtain which could be drawn across the wall during late summer afternoon.



HEATING
NOW

COOLGARDIE
SAFE

GREEN HOUSE



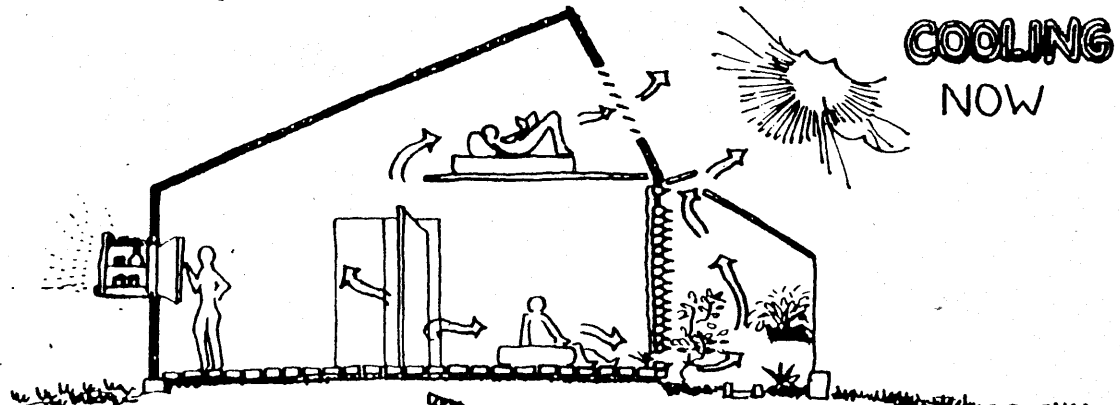
HEATING
ALTERNATIVE

HEATING ALTERNATIVE

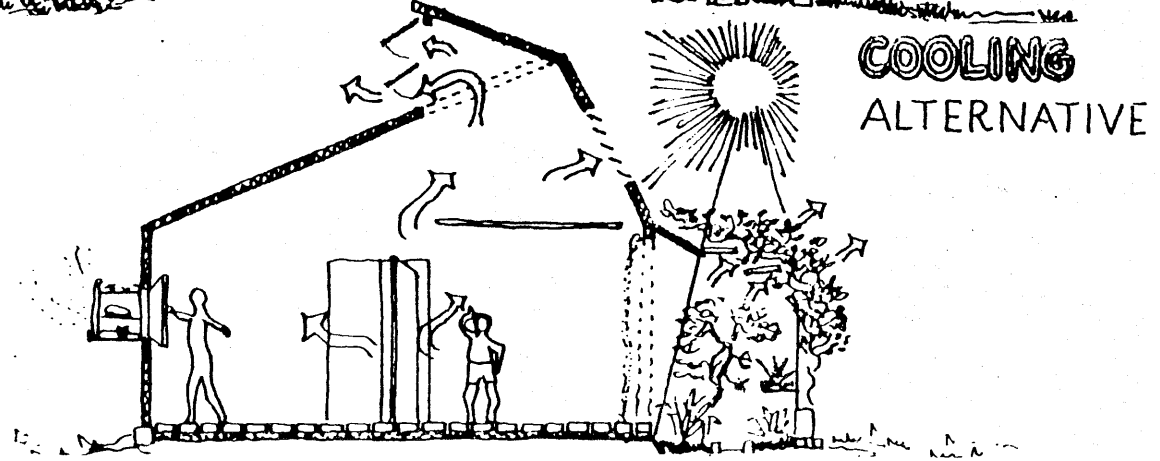
Replacing the bottle wall ambient heat store with masonry floor, with dark surface insulated at edges, exposed to northern sunlight. Floor heats up, acting as a heat store, and releases heat slowly overnight and cool days. In the evenings, heavy curtains and doors can be drawn across the north facing opening to trap this heat in the house. Deciduous vines could be grown over the greenhouse.

HEATING/COOLING ALTERNATIVES

It may not be desirable to use the entire northern wall of a house as a heating unit. Instead of building a heat storing wall along the sunny side of the house, one could use the floor as the heat store.



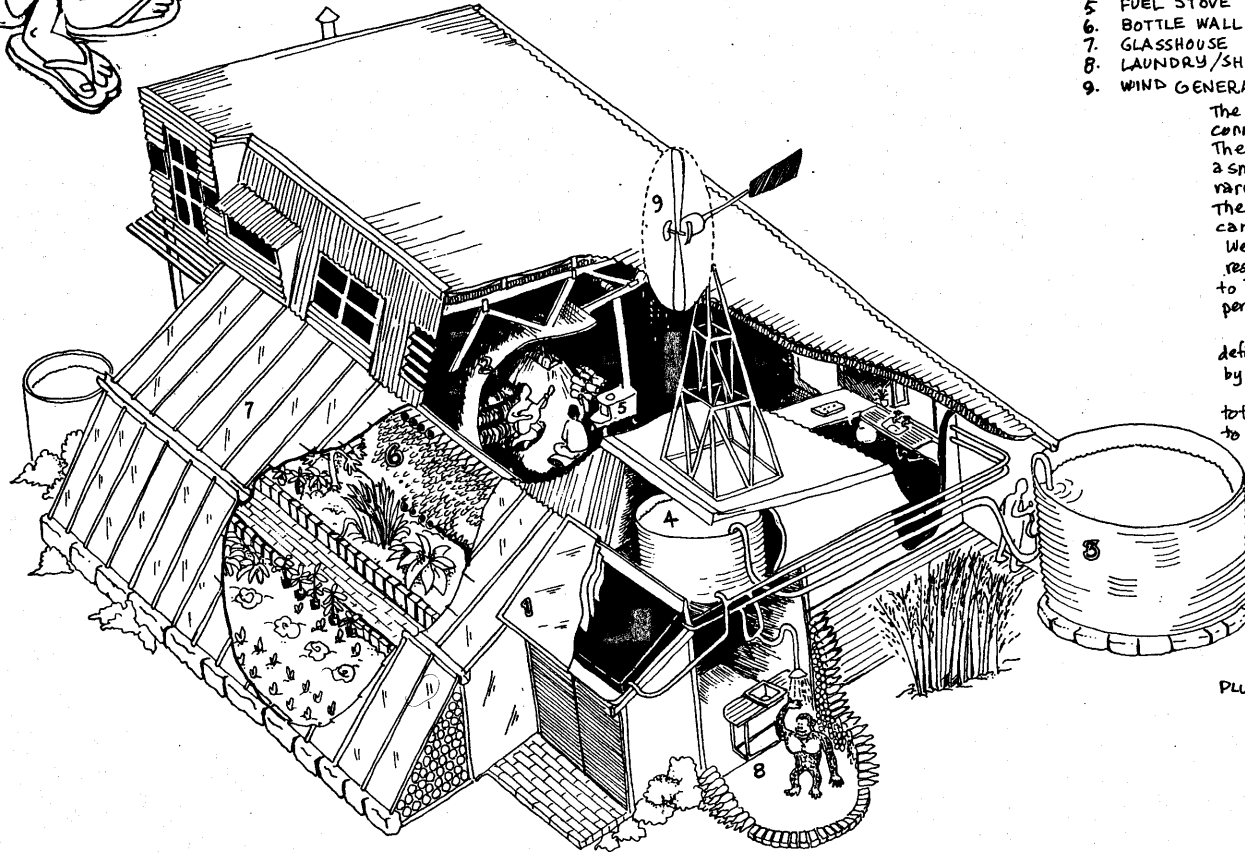
COOLING
NOW



COOLING
ALTERNATIVE



ROOFING - Recycled galvanised iron. Repaired with canvas and hydroseal - then painted
 Roof laid over double-sided aluminium sarking and aluminium sided glass-fibre insulation - shiny side down.
 The roof is supported by gangnail trusses spanning 6 metres, at 2 metre spacings



1. SOLAR WATER HEATER & HOT WATER STORAGE - further information page 7
2. LOFT - PRIVATE SPACE & SLEEPING
3. RAINWATER STORAGE
4. HEADER TANK
5. FUEL STOVE
6. BOTTLE WALL - further information page 8
7. GLASSHOUSE
8. LAUNDRY/SHOWER
9. WIND GENERATOR - 200 watt.

The generator charges two 6 volt home lighting batteries connected in series - providing a 12 volt power source. The electricity generated is used solely for lighting and a small radio. The house has 7 light points with rarely more than 3 being used at any one time. The lights used are 13 watt fluorescent tubes - as used in caravans.

We have found that we can remain self sufficient in this respect for possibly 7 months of the year. From March to July there is a wind drought and the batteries need periodic recharging from mains supply.

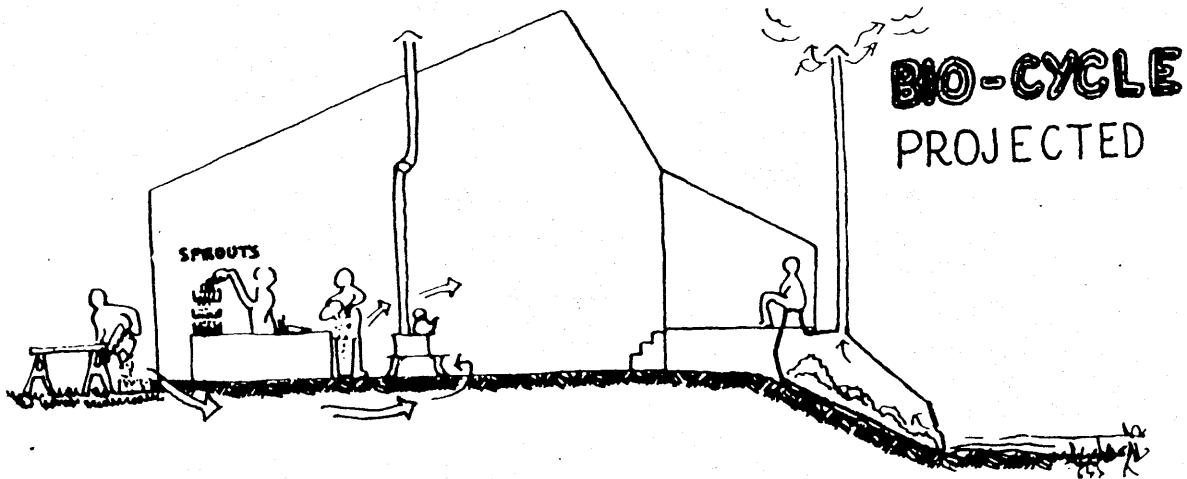
The year round performance of the generator would definitely be improved if the site was not surrounded by tall buildings.

It is significant to note that with all lights on - the total power consumption is only 91 watts - equivalent to 2 incandescent bulbs in the average house

PLUMBING - P.V.C. garden hose is used for water supply, connected with standard brass fittings, as water pressure is low - gravity feed from header tank. P.V.C. hose can be expected to last at least 4-5 years (our experience) if not exposed to ultra-violet light.

GLASSHOUSE - The top section of the glasshouse was bought for \$25 from a market garden - sometimes they are free if you take everything away. If bought new they are still a cheap way of enclosing space - horticultural glass being the cheapest available. approx \$25.00/100 ft².

FLOORING - Bricks laid on 75 m.m. sand over polythene sheet water barrier. all over compacted rubble fill.



BIO-FUELS

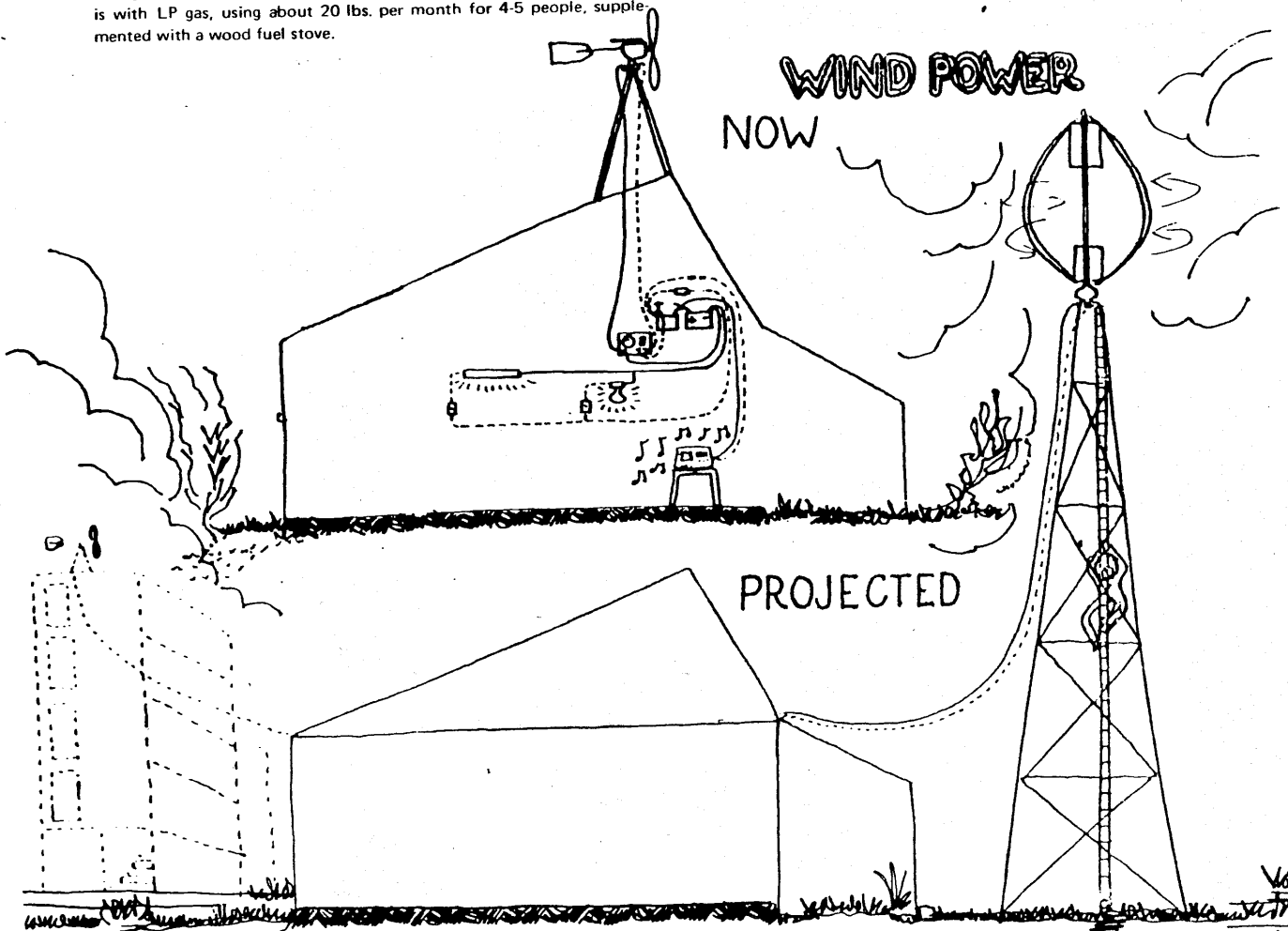
NOW - Methane digester is dismantled. The local health authority requirement was to build it of concrete and take out a \$50,000 insurance policy on explosion. However it is doubtful whether a methane digester is appropriate at the scale of one household (even if supplemented with domestic fowls and pigs). On a small scale, the controls over: temperature; C/N ratio; pH factor; prevention of antibiotics (from human wasters) killing the bacteria in the tank, need to be much finer and are difficult to achieve. It is also highly unlikely that enough gas could be generated for all cooking needs. Present cooking is with LP gas, using about 20 lbs. per month for 4-5 people, supplemented with a wood fuel stove.

BIO-CYCLE

PROJECTED - Food scraps, human wastes, sawdust, ash and grass clippings go to CLIVUS composter, and the compost is to go on the gardens.

Timber off-cuts and waste paper to be used in fuel stove.

Experiments have been conducted on our diet - eating raw vegetables and fruits, 'cooking with water rather than fire', e.g. sprouting seeds and eating them. Reliance on cooking can be reduced and in Australia's hot summers this is desirable.



WIND POWER

NOW - This small wind generator (manufactured by Quirks) is to power 5 lights, a small transistor radio and a small freezer unit.

The wind generator should be at least 4 1/2 metres above any obstruction within 120 metres. There are 5 and 6 storey University buildings well within that limit.

In this location the wind changes direction often and our generator, mounted on horizontal axis, has to turn often to catch the wind. So far, our power output has been nowhere near what the system is supposed to be able to provide.

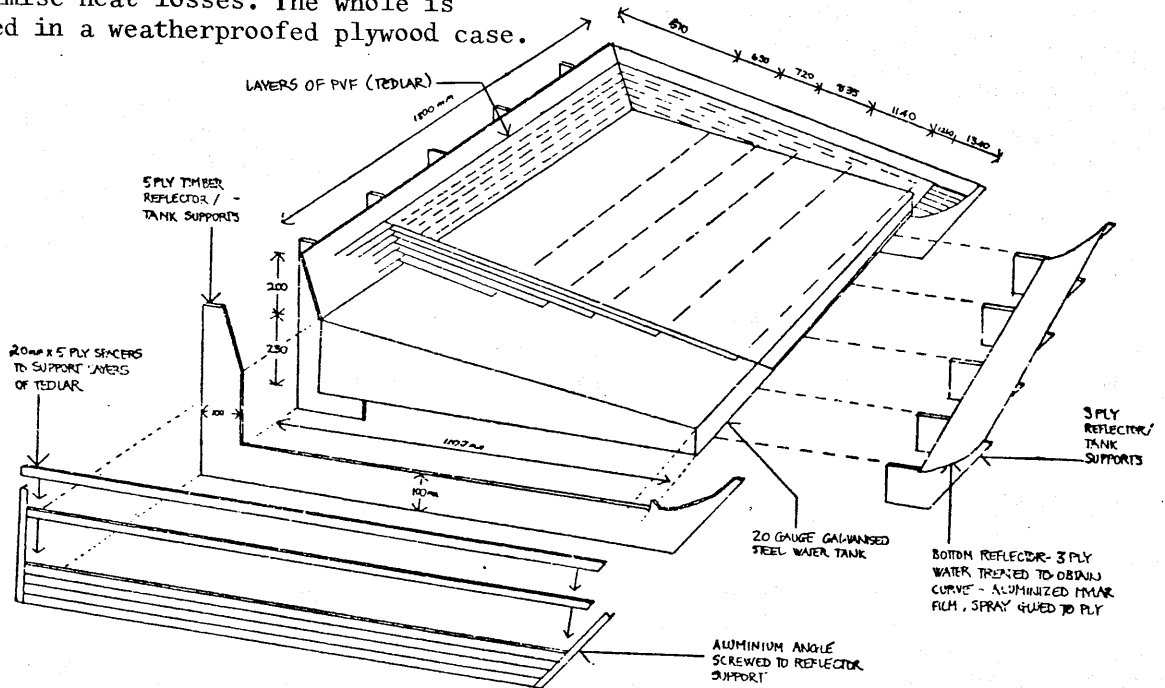
PROJECTED - The wind generator could be better located on top of the tall buildings nearby, or build a higher tower, and use a rotor that spins on a vertical axis - such as a Darrieus rotor or Savonius rotor.

SOLAR HOT WATER SYSTEM DETAILS

Principal: This heater was designed for minimum cost, and where the main water use is at the end of the day. It is not intended to store hot water over a long period of time.

A flat, shallow tank contains water. It is blackened on one side, and contains an inlet and outlet pipe as shown below. The tank has insulating layers of Poly-Vinyl Fluoride plastic (DuPont TEDLAR), which allows solar radiation through, but inhibits re-radiation from the hot tank. There is a 100mm (4 in.) layer of ACI Pink Batts around and under the tank to minimise heat losses. The whole is enclosed in a weatherproofed plywood case.

Performance: This heater was installed in Spring 1977, after the completion of thermocouple testing. Temperatures have reached 80 deg. C, with an average of 45-55 C for a normal sunny day. The main problem is heat loss from the large body of hot water through the PVF. This could be minimised by using a selective surface on the tank, and/or a cover at night and on cloudy days. It is possible to use other means (eg a fuel stove etc) to boost temperatures during cloudy periods, provided the water circulation is not impeded.



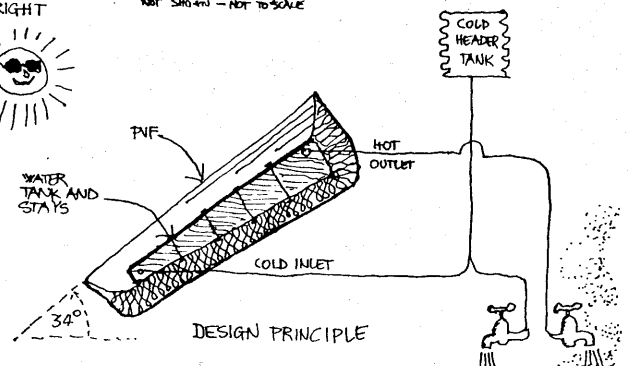
Construction: The tank was fabricated from 2 2400mmx1800mm 20 gauge galvanized steel, as the experiment is low cost and of relatively short life. Copper would be a better alternative. There are 16 $\frac{1}{4}$ " tie rods from the front to back face of the tank, fixed by bolts and washers and silver soldered to prevent ballooning of the tank under the water pressure. The inlet and outlet pipes are normal $\frac{3}{4}$ " galvanized pipe fitted into standard plumbing sockets. All the joints are lock-seamed and silver soldered.

The tank is supported on plywood ribs as shown, to provide minimum heat transfer to the outside.

Each layer of PVF is attached to the plywood spacers, and the layers are built up as shown. The length of each layer is arbitrary, being derived from the size of a standard PVF roll to eliminate waste. The casing is made of $\frac{1}{4}$ " ply, undercoated and painted with 2 coats of exterior gloss paint. All joints are caulked with Butyl Mastic.

SOLAR WATER HEATER
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VIEW SHOWN GENERAL CONSTRUCTION - COATING NOT SHOWN - NOT TO SCALE



This is not the only way to build a solar collector. Some people claim this principle is inherently unsuitable because of re-radiation losses. Others say it eliminates the need for (and the cost of) a separate hot water storage tank.

We think it works well for us.

(Thanks to Michael Ling of Solarhot Water Systems for assistance.)

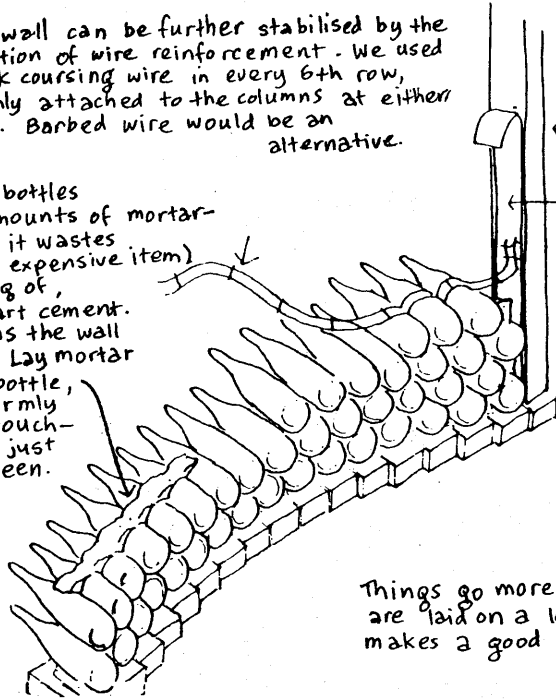
BUILDING BOTTLE WALLS - Raw materials are easily come by - cruising the streets on garbage nights can be very rewarding. Wine bars and restaurants are another reliable source. Just about any type of bottle is suitable but beer bottles are plentiful and have a nice colouring when viewed between your eye and the sun.

After gathering the requisite number of bottles (you will need about 672 for a wall 2 metres square) the next step is cleaning them. Labels absorb moisture from the cement and detach themselves from the bottles, meaning that the bottle will possibly pull free of the wall.

The wall can be further stabilised by the addition of wire reinforcement. We used brick coursing wire in every 6th row, firmly attached to the columns at either end. Barbed wire would be an alternative.

Try not to have the bottles separated by vast amounts of mortar - besides looking ugly it wastes cement (the most expensive item) Use mortar consisting of,

5 parts sand : 1 part cement. This is not critical as the wall is not loadbearing. Lay mortar along shoulder of bottle, bed bottles down firmly, so that the sides touch - the mortar should just fill the gaps in between.



Timber column to support wall at each end.

Building paper or waterproof material to prevent column absorbing moisture from the mortar.

Work from this side of the wall lining up the bases of the bottles as you go. It is a simple matter to curve the wall in both the horizontal and vertical directions.

Things go more smoothly if the bottles are laid on a level base, a row of bricks makes a good footing.

Lay the bottles with the necks pointing outwards, unless you like the company of the spiders and other creatures which will invariably inhabit the interior of the bottles. If the wall is to be used as a heat store (see references elsewhere) then the bottles will be filled with water and capped (crown sealing is easiest for a large number of bottles) before laying.

It is a good idea to clean the excess mortar off the bottles as they are laid - once the mortar has hardened it's a real bugger to remove. Lime added to the mortar during mixing will also facilitate cleaning.

THE ANOMALOUS HOUSE

A RESIDENT REFLECTS

There is something strange about this Autonomous House. Though at times it is difficult to pinpoint what it is. But, often a visitor, seeing the house for the first time will sense the strangeness intuitively, asking questions like -

'And people actually live here?'

'But why did you build it here, isn't it more suited to the countryside?'

Of course many of those who come to see the house often do so after having seen a newspaper article or television programme on it, which inevitably foster false expectations with their glossy journalism and larger than life images. But this media distortion is not what I mean. Often comments like the ones above are quite understandable.

But what is really strange is that just as many people come to the house expressing sympathy and support for what is being done, eager to exchange experiences and news of other similar activities. They see the Autonomous House as a meaningful thing: despite what you might tell them about there being barely enough wind power at all times to run the small electrical appliances and that the methane digester is not connected yet and maybe it won't work so well anyway, or that we use a wood burning stove in winter to boost the solar space heating wall and overcome the heat leaks. The fact that in technological terms the project is a bit flimsy does not seem to matter to these people as much as would be expected of a project with as pretentious a name as The Autonomous House.

I sometimes find this a bit strange - even worrying. Though we might be seen by some to be perpetrating a confidence trick in presenting a rural shack as the house of the future. None of us working on the project are technologists, amateur or professional, and we have not really come up with any startling new technological devices (though we have got tons of ideas and suggestions). So what is it that people see of value here?

Living at the house, I began to see more and more the workings of my needs and the technology created to satisfy those needs. In an unexpected way the lack of sophisticated technical skill and resources here was an asset. If we really want to begin living in ecological harmony with earth (and more creatively, because I think the two are linked) then we must reconsider our style of living as much as our techniques.

And to the question asked surprisingly often by visitors to the house - 'But is there a wind generator capable of running my 240 volt stereo system?'

the answer might be -

'Take up the flute.'

In addition, if we consider that 70-80% of domestic energy consumption is used for water and space heating, then by merely making a house well insulated and properly orientated and by incorporating some simple solar heating devices we can cut our energy consumption by so much that it becomes maybe pointless to put considerable amounts of effort into esoteric alternative technologies just to retrieve the remaining 30%.

Perhaps it is not so absurd to see The Autonomous House as a prototype of the house of the future. A prototype not defined by engineering specifications or measured with thermometers and galvanometers but as a process of people living together, and working together with the goal of living more creatively, not confining themselves to the narrower horizons of efficiency and convenience.